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TAX PRINCIPLES AND TAX HARMONIZATION UNDER IMPERFECT COMPETITION: A CAUTIONARY EXAMPLE

Michael Keen
Sajal Lahiri
Pascalis Raimondos-Møller*

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CESifo
Center for Economic Studies & Ifo Institute for Economic Research
Poschingerstr. 5, 81679 Munich, Germany
Phone: +49 (89) 9224-1410 - Fax: +49 (89) 9224-1409
e-mail: office@CESifo.de
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Abstract

This paper shows that under imperfect competition the welfare effects of indirect tax harmonization may depend crucially on whether taxes are levied by the destination or the origin principle. In a standard model of imperfect competition, while harmonization always makes at least one country better off, and may be Pareto-improving, when taxes are levied under the destination principle (which currently applies in the European Union), harmonization of origin-based taxes (as recently proposed by the European Commission) is certain to be Pareto-worsening when the preferences in the two countries are identical, and is likely to be so even when they differ.

Keywords: Harmonization, destination principle, origin principle, commodity taxation.

JEL Classification: H1.

Michael Keen
Fiscal Affairs Department
International Monetary Fund
Washington DC 20431
USA

Sajal Lahiri
Department of Economics
University of Essex
Colchester CO4 3SQ
United Kingdom

Pascalis Raimondos-Møller
Department of Economics
Copenhagen Business School
Frederiksberg 2000
Denmark
Pascalis.Raimondos-Moller@econ.ku.dk

1 Introduction

In 1997 the European Commission proposed a radical reform of value-added taxation that, in essence, can be decomposed in two parts: (a) a shift from the current destination principle (under which taxes are paid in the country where the good is consumed) to the origin principle (under which taxes are paid in the country where the good is produced); and (b) harmonization of tax rates across member states.[1] While each part of such a reform can be (and has been) addressed as a policy issue in its own right, this paper presents an example which shows very starkly that they should not be considered in isolation. In particular it is shown that when product markets are characterised by imperfect competition, the welfare implications of step (b) depend crucially on the principle of taxation applied in step (a).

The literature comparing destination and origin-based commodity taxation is now extensive: see Lockwood (1999) for a thorough and unified account. The comparative effects of tax harmonization under the two principles, however, have not been fully explored. It is known that with perfectly competitive product markets a harmonization of commodity taxes towards an appropriately weighted average of their initial values in the participating countries is potentially Pareto improving under both destination and origin principles (see Keen (1987,1989) for the former and Lopez-Garcia (1994) for the latter): that is, with appropriate compensating payments between them, all countries can gain from such a reform.[2] In the competitive case, the principle by which taxes are levied is thus irrelevant to the efficiency case for their harmonization. However, knowledge of the welfare implications of commodity tax harmonization when product markets are imperfectly competitive remains limited. For a simple duopoly model, Keen and Lahiri (1993) show that the same form of harmonization continues to be potentially improving under the destination principle; and Keen and Lahiri (1998)

[1] The proposal was not well received by all member states.

[2] The analysis is extended to include a government revenue constraint in Delipalla (1997), Lockwood (1997), Lopez-Garcia (1998), and Lahiri and Raimondos-Møller (1998).

analyze the welfare effect of a shift from destination to origin principles.[3] But neither paper considers tax harmonization under the origin principle.[4]

Using the model of Keen and Lahiri (1993, 1998), the paper shows that when preferences are identical preferences across countries harmonization of destination-based commodity taxes (starting from the non-cooperative equilibrium) always makes one country better off and may be Pareto-improving, any harmonization of origin-based taxes (again, from the non-cooperative equilibrium) is *sure* to lead to a strict Pareto *worsening*. Even when preferences are not identical, we find that the same result is likely to hold under reasonable assumptions. This striking result adds a note of caution to the ongoing discussion on commodity tax reform in the European Union. For here is a clear case in which, even putting revenue effects to one side, harmonization is unambiguously *bad* policy.

The paper proceeds as follows. The next section analyzes destination-based taxes and establishes conditions under which harmonization leads to a strict Pareto improvement. Section 3 shows that harmonization is Pareto-worsening under the origin principle. Concluding remarks are in section 4.

2 Destination-based commodity taxes

We use the model of Keen and Lahiri (1993), which is one of imperfect competition in the market for a homogeneous good. In the background there is a second commodity, traded internationally in a competitive market. This is taken as numeraire. Both goods require a single internationally immobile factor of production and are produced under constant returns. With these assumptions, the price of the single factor (and thus its supply) gets tied down by the zero-profit condition in the numeraire-good sector. This then also ties down the average variable and marginal costs of production

[3] Haufler et al. (2000) extend the Keen and Lahiri (1998) analysis to include trade costs.

[4] Nor does Lockwood (1999), whose model has the feature that equilibrium taxes do not differ across countries under the origin principle.

in the imperfectly competitive sector.

There are two countries, 'home' and 'foreign'(the latter indicated by an asterisk),[5] and a single representative consumer in each. Preferences may differ between the two countries. Indirect utilities in the two countries are assumed to be of the quasi-linear form:[6]

$$\begin{aligned} W(P,Y) &= \frac{1}{2}\beta P^2 - \alpha P + Y, \\ W^*(P^*,Y^*) &= \frac{1}{2}\beta^*(P^*)^2 - \alpha^* P^* + Y^*, \end{aligned}$$

where P and P^* denote consumer prices, and Y and Y^* lump-sum income, in the two countries, and $(\alpha, \alpha^*, \beta, \beta^*) > 0$.

Using Roy's identity, the demand functions for the good produced under imperfect competition (derived from the above indirect utility functions) are linear in price and independent of income:[7]

$$D = \alpha - \beta P, \qquad D^* = \alpha^* - \beta^* P^*, \tag{1}$$

where D and D^* are home and foreign demand respectively. The market for the product is internationally integrated, so that equilibrium requires:

$$D + D^* = X + X^*, \tag{2}$$

where outputs in the two countries are denoted by X and X^*. In this section, taxes t_d and t_d^* are levied on a destination basis, i.e. are specified by, and paid to, the country where the good is consumed.[8] Arbitrage then equates consumer prices minus taxes across the two countries, so that

$$P - t_d = P^* - t_d^* = P_w, \tag{3}$$

[5]There is no particular significance behind the choice of these terms. The two countries are treated symmetrically and there is no special concern for the home country in this paper.

[6]Note that if the supply of the factor is elastic, its price should also appear as an argument in the indirect utility function. However, since the factor price does not change in our analysis, it is dropped from the argument of the indirect utility function.

[7]Thus income effects fall entirely on the numeraire.

[8]If both goods were taxed at the same rate in each country, origin and destination bases would be equivalent (Lockwood, Myles and de Meza (1994)). In practice, however, rates of VAT and, in particular, excises on particular goods commonly vary widely across commodities. We therefore assume the tax rates for the two goods to be different. Since we normalize the consumer price of the numeraire good to unity, the tax rate for the imperfectly competitive good is a relative one. However, it is convenient, and without any loss of generality, to take the numeraire good to be untaxed.

with P_w being the world price of the taxed good.

There are two firms, one in each country. With the price of the single factor tied down by the competitive sector (see the discussion at the beginning of this section), the average variable and marginal costs remain constant through the analysis, but potentially differ between firms. With taxes and arbitrage as described above, profits are

$$\Pi = (P_w - c)X - F, \quad \Pi^* = (P_w - c^*)X^* - F^*, \tag{4}$$

where c and F denote marginal and fixed costs of the home firm, c^* and F^* being the foreign analogues.

Equilibrium is the outcome of a two-stage game. At stage one, the governments set their taxes (simultaneously and non-cooperatively) so as to maximize the welfare of their representative agent; at stage two the firms behave optimally under the assumption of Cournot competition. We use backward induction to solve for the subgame perfect equilibrium.

At stage two, firms maximize profits taking taxes as given. From (1) and (2) and writing $b = 1/(\beta + \beta^*)$, the aggregate inverse demand function is

$$P_w = b(\alpha + \alpha^*) - b(X + X^*) - \beta b t_d - \beta^* b t_d^*, \tag{5}$$

from which, using (4), the Cournot-Nash profit maximizing conditions are as:

$$P_w - c = bX \quad \text{and} \quad P_w - c^* = bX^*. \tag{6}$$

At stage one, the governments set taxes taking into account the subsequent reactions of the firms. It is assumed that the profits of each firm accrue to the representative consumer of that country as lump-sum income, as does tax revenue.[9] The utilities of the representative agent in the two countries are then the sum of consumer and producer surplus plus consumption tax revenues:

$$W = \mathrm{CS} + Y, \quad \text{and} \quad W^* = \mathrm{CS}^* + Y^*, \tag{7}$$

[9] Since the purpose of this exercise is simply to provide a sharp example, we abstract from any revenue constraints.

where

$$Y = \Pi + t_d D, \qquad Y^* = \Pi^* + t_d^* D^*, \tag{8}$$

$$d\mathrm{CS} = -D dP, \qquad \text{and} \qquad d\mathrm{CS}^* = -D^* dP^*. \tag{9}$$

Total differentiation of (7) gives, using (9):

$$dW = A_1 dt_d + A_2 dt_d^* \qquad \text{and} \qquad dW^* = A_1^* dt_d + A_2^* dt_d^* \tag{10}$$

where

$$\begin{array}{ll} A_1 = [b(D-2X) - b(2\beta + 3\beta^*)t_d]\,\beta/3, & A_1^* = A_2^*\beta/\beta^* + \beta t_d^*, \\ A_2^* = [b(D^*-2X^*) - b(2\beta^* + 3\beta^*)t_d^*]\,\beta^*/3, & A_2 = A_1\beta^*/\beta + \beta^* t_d. \end{array}$$

The equilibrium tax rates are then derived by setting:

$$A_1 = 0 \qquad \Longleftrightarrow \qquad t_d = \frac{D-2X}{2\beta + 3\beta^*}, \tag{11}$$

$$A_2^* = 0 \qquad \Longleftrightarrow \qquad t_d^* = \frac{D^*-2X^*}{2\beta^* + 3\beta}. \tag{12}$$

It is clear from (11) and (12) that the optimal tax for the country that exports this good is unambiguously negative, but the sign for the importer is ambiguous. The intuition is clear. There are two forces at work. One is the standard terms of trade effect: a consumption subsidy increases domestic demand and therefore the international price. This is clearly good for the exporting country and bad for the importing. The other is the Marshallian subsidy argument: a consumption subsidy reduces the monopoly distortion. For the exporting country, both effects work in the same direction and so the optimal tax is unambiguously negative. For the importing country, however, the tax is positive if and only if the terms-of-trade effect dominates the Marshallian effect. We assume, without loss of generality, that the foreign country exports the good under consideration (i.e. $D^* < X^*$) so that $t_d^{N*} < 0$, the superscript N indicating the Nash game.

Turning to the welfare effects of harmonization, note first that using (11) and (12) to evaluate (10) at the Nash equilibrium gives

$$dW = \beta^* t_d^N dt_d^* \qquad \text{and} \qquad dW^* = \beta t_d^{N*} dt_d. \tag{13}$$

and consider then the effects of harmonizing taxes in the very general sense of moving taxes in each country toward some weighted average $H = \lambda t_d + (1-\lambda)t_d^*$, where $\lambda \in (0,1)$:

$$\begin{aligned} dt_d &= \delta(H - t_d) \\ dt_d^* &= \delta(H - t_d^*), \end{aligned} \tag{14}$$

where δ is a small positive scalar.

Taking first the special case in which $\lambda = \beta b$ (which is the form considered in Lahiri and Keen (1993), (13) implies that:

$$d(W + W^*) = \delta\beta\beta^* b \left(t_d^N - t_d^{N*}\right)^2 > 0. \tag{15}$$

That is, the harmonization to the particular weighted average, with the weights reflecting relative slopes of demand curves, in (14) is potentially Pareto improving: both countries can gain from harmonization if appropriate compensation is paid between them. Clearly then at least one country must gain from such harmonization.

Under what circumstances will both gain even without compensation being paid? We have seen above that $t_d^{N*} < 0$. If we can show that $t_d^N > 0$, then clearly $t_d^N > t_d^{N*}$ and any harmonization of the form in (14)rule will mean raising the foreign tax and lowering the home. But then (13) implies that both countries benefit from the harmonization.[10] Thus harmonization is sure to benefit the exporting country, and is Pareto-improving if and only if each country taxes the good that it imports more heavily than that it exports.[11] >From (11), it follows that t_d^N will indeed be positive if and only if $X/D < 1/2$, i.e. the home firm has less than 50 percent of the domestic market.

[10] This conclusion that both countries will gain from harmonization if and only if their initial tax rates differ in sign is reminiscent of, but distinct from, Proposition 1(c) of Keen and Lahiri (1993). This proposition shows that when both destination-based taxes and production subsidies are deployed it is necessary and sufficient for harmonization to a particular weighted average (from the non-cooperative equilibrium) to be strictly Pareto improving that taxes in the two countries have opposite sign; here, however, the movement is to any weighted average, and production subsidies are not available.

[11] This latter conclusion is consistent with Proposition 7 of Lockwood (1999).

These results can be given a simple intuition. Consider first the effects of harmonization from the perspective of the low tax (foreign) exporting country. As an envelope property, welfare is affected only by the reduction in the home country's tax. This has three effects:[12] a beneficial terms of trade effect (since the increase in home demand raises the world price of the foreign country's exportable); an expansion of the foreign country's output (beneficial because, from (6), the world price exceeds marginal costs); and a contraction of domestic demand (beneficial because the negative consumption tax means that the value of selling the good on the world market exceeds that of domestic consumption). From the perspective of the home country, on the other hand, all that matters is the increase in the foreign country's tax rate. This too shifts consumption in the direction of the home country, which consequently gains if the price it pays for the good (the world price) is less than the value domestic consumers place upon it (measured by the home consumer price): thus it is that, as in (13), the home country also benefits from harmonization if and only if the tax rate there is initially positive.

3 Origin-based commodity taxes

Having presented the model in detail for the case of destination taxes, we can deal more briefly with the case of origin-based taxes. We simply amend the model to have taxes levied on an origin basis: that is, levied at a rate specified by and paid to the country in which the commodity is produced (rather than, as under the destination principle, in the country which it is consumed).

The demand functions and the world market equilibrium are exactly as in (1) and (2). Given that taxes t_o and t_o^* are now levied on an origin basis, international arbitrage equates consumer prices across the two countries, so that $P = P^* = P_w$. The only other change is in the description of the profit functions, which are now:

$$\Pi = (P_w - t_o - c)X - F, \qquad \Pi^* = (P_w - t_o^* - c^*)X^* - F^*. \tag{16}$$

[12] Perturbing (7) gives $dW^* = (X^* - D^*)dP_w + (P_w - c^*)dX^* + t^*dD^*$.

Using (1) and (2), the aggregate inverse demand function is $P_w = b(\alpha+\alpha^*)-b(X+X^*)$. With the firms behaving as Cournot competitors, profit maximization now requires that:

$$P_w - c - t_o = bX \quad \text{and} \quad P_w - c^* - t_o^* = bX^*. \tag{17}$$

Given the same indirect utility functions as in (7), but now with tax revenue of t_oX, the relevant welfare expressions turn out to be:

$$3\ dW = A_3 dt_o + A_4 dt_o^*, \qquad \text{and} \qquad 3\ dW^* = A_3^* dt_o^* + A_4^* dt_o, \tag{18}$$

where

$$\begin{array}{ll} A_3 = -[D + X + 2t_o/b], & A_3^* = -[D^* + X^* + 2t_o^*/b], \\ A_4 = -[D - 2X - t_o/b], & A_4^* = -[D^* - 2X^* - t_o^*/b]. \end{array}$$

Setting $A_3 = 0$ and $A_3^* = 0$ gives the Nash tax rates:

$$t_o^N = -\frac{b(D+X)}{2}, \quad \text{and} \quad t_o^{N*} = -\frac{b(D^*+X^*)}{2}. \tag{19}$$

Using (2), we see from (19) that

$$t_o^{N*} \gtreqless t_o^N \qquad \Longleftrightarrow \qquad D^* \lesseqgtr X. \tag{20}$$

Moreover, substituting the values of the Nash tax rates into (18), we get:

$$2\ dW = (X - D)dt_o^*, \qquad \text{and} \qquad 2\ dW^* = (X^* - D^*)dt_o. \tag{21}$$

The implication is very straightforward. Harmonization is in this case Pareto improving if and only if the low tax country (obliged by harmonization to raise its tax rate) is an importer of the taxed good (and the high tax country, correspondingly, is an exporter). The intuition for this follows on considering why it is that a country emerges as an importer in the Nash equilibrium. This is for either or both of two reasons: because it has higher costs, and therefore lower output; or because it has stronger demand. On the first count, the country tends to set too low a tax rate, since in the first best the relatively inefficient firm should be driven out (by an exorbitant

tax). On the second count, it sets too low a tax because of its concern for consumers' surplus (which is high).

Pursuing the implications of (21) further, consider first the case in which preferences are the same in the two countries, so that $D = D^*$. Then, using (17) and (19), it can be shown that $t_o^N - t_o^{N*} = c - c^*$. That is, the low cost country imposes a lower tax than the high cost one (reflecting the greater strength of its rent-shifting effect). Clearly then the low tax, low cost country will have higher output; and with demand the same in the two countries it will also be the exporter of the taxed good. Assuming without loss of generality that $c > c^*$, so that $t_o^N > t_o^{N*}$, $X^* > D^*$ and $X < D$, it immediately follows that any tax harmonization, moving both countries towards a weighted average of the rates from which they start,[13] strictly *reduces* the welfare of each.

The reason is simple. The first best policy — i.e. that which maximizes global welfare — is to impose a heavy tax on the more inefficient firm – enough, ideally, to drive it out of business – and pay a Marshallian subsidy to the more efficient firm:[14] roughly speaking, the former (aimed at reallocating production across countries) promotes production efficiency whilst the latter (aimed at the monopoly distortion) promotes allocative efficiency. The non-cooperative equilibrium, as we have seen, has the property that the tax is indeed higher for the more inefficient firm. But although self-interest thus leads to the heavy taxation of the less efficient firm, the interest of each country in obtaining some profit income means that this tendency is not pushed as far as countries would, if they were able to cooperate effectively, ideally wish. Harmonization, which means lowering the tax on the less efficient firm and raising it on the more efficient, moves taxes in exactly the wrong direction: efficiency calls for *more* dissimilarity in tax rates, not less.

[13] It is to be noted that in the literature analysis is typically conducted with specific weights. Here we do not need to specify the weights; what we say is true for any weights lying between 0 and 1.

[14] Implicitly, we assume that the fixed costs have already been incurred before government policies are made so that in deciding the first-best policy the governments ignore the fixed costs.

Turning to the more general case where preferences in the two countries are not necessarily the same, raising the possibility that $D \neq D^*$, suppose without substantive loss of generality that $X > D^*$ and hence $t_o^{N*} > t_o^N$. Following Jones (1985), it is further assumed that demand is higher in the importing country so that $D^* > D$. Thus $X > D^* > D$. Rewriting (21) as

$$2\ dW = (X - D^* + D^* - D)dt_o^*, \qquad \text{and} \qquad 2\ dW^* = (D - X)dt_o,$$

we again find that any tax harmonization, moving both countries towards some weighted average of the rates from which they start, strictly *reduces* the welfare of each.

4 Concluding remarks

While the purpose here has been to present an instructive example, not to seek maximum generality, two possible extensions to the analysis, suggested by a referee, merit some comment. First, one can conceive of there being many imperfectly competitive sectors, rather than just one. If distinct tax rates can be applied to each — corresponding to excises rather than a broad-based sales tax — then (given assumption akin to those above, together with an absence of cross-price effects) conclusions similar to those above will apply. When the same ad valorem tax rate must be applied to all sectors, however, there is clearly scope for greater ambiguity of outcomes. Second, by assuming that there are no costs to the movement of goods other than those related to tax, the analysis has precluded price discrimination between the two countries; this too would clearly call for a very different analysis.

What the results here do show clearly is the interdependence between the proper answers to the two key questions that arise in designing indirect taxes in an increasingly integrated world: Should those taxes be levied by the destination or origin principle? Should they be harmonized across countries? These two questions — which hitherto have been, without exception, analysed separately — cannot be answered independently of one another. Harmonization may be good policy when taxes are levied on

a destination principle (because, very loosely speaking, it alleviates the inefficiency in the international allocation of consumption implied by tax-induced differences in consumer prices) but bad policy if taxes are levied on an origin basis (because it worsens production inefficiencies by moving production away from the low cost—and so, in equilibrium, low tax—country). Although we make the above point with the help of a very specific model, this provides a stark illustration of the more general point that the desirability of harmonizing some aspects of policy is liable to depend on the wider economic context within which that harmonization occurs. Generalizations as to the merits (or otherwise) of policy convergence are for this reason, and others, to be mistrusted.

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